Health Consultation

Perchlorate Contamination in the
Fair Oaks Water District

AEROJET GENERAL CORPORATION

RANCHO CORDOVA, SACRAMENTO COUNTY, CALIFORNIA

CERCLIS NO. CAD980358832

JUNE 5, 1998

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

PERCHLORATE CONTAMINATION IN THE FAIR OAKS WATER DISTRICT

AEROJET GENERAL CORPORATION

RANCHO CORDOVA, SACRAMENTO COUNTY, CALIFORNIA

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Prepared by:

California Department of Health Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUE

The California Department of Health Services (CDHS), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), is conducting public health assessment activities on the Aerojet-General Corporation (Aerojet) Superfund site in Sacramento County, California (Figure 1). A preliminary public health assessment written in December 1988 recommended that when additional environmental information and data became available ATSDR would make another assessment (1). A site review and update written in March 1993 also recommended a public health assessment be conducted when more data became available (2).

This health consultation is one in a series that will be performed as part of the ATSDR public health assessment process at this site. During this process, data and information on the release of hazardous substances and their impact on public health will be evaluated. Four health consultations have recently been written as part of this series (3-6). In this health consultation, we will focus on describing the perchlorate testing that has been conducted at the Fair Oaks Water District (Figure 2). We are also in the process of writing several other health consultations that focus on perchlorate exposure to consumers of water from other water purveyors in the area and from private wells in the area. In addition, we are also writing a health consultation that describes the perchlorate groundwater contamination west of the Aerojet Superfund site.

Aerojet began operation in 1951. Since that time, Aerojet has manufactured liquid and solid propellants for military and commercial rocket systems and has fabricated, assembled, tested and rehabilitated rocket engines (1). In addition, between 1974 and 1979, Cordova Chemical Company, a wholly-owned subsidiary of Aerojet, manufactured paint components, herbicides, and pharmaceutical products. Over the years, Aerojet and Cordova Chemical disposed of hazardous waste by burial, open burning, discharge into unlined ponds, and injection into deep underground wells (1). Some of these discharges, including perchlorate, have contaminated the environment and have moved off-site of the Aerojet facility boundary (Figure 1). Perchlorate in the groundwater arises from ammonium perchlorate being a main component of solid rocket fuel. In addition to the natural migration of perchlorate-contaminated groundwater from the site, Aerojet is reinjecting treated groundwater, contaminated with perchlorate, at the site's western and northern boundary. The Regional Water Quality Control Board (RWQCB), the California Department of Toxic Substances Control (DTSC) and the U.S. Environmental Protection Agency (USEPA), are the lead regulatory agencies overseeing groundwater investigation and cleanup at Aerojet, and are also investigating other sources of the perchlorate, such as the McDonnell Douglas (now Boeing) and Purity Oil Sales sites.

Fair Oaks Water District

The Fair Oaks Water District began as an irrigation district in 1917 to serve the agricultural area located north of the American River, approximately 20 miles northeast of the City of

Sacramento. Today, the water district encompasses the community of Fair Oaks and a portion of Orangevale. As of May 16, 1997, the district had 12, 938 connections: 12,293 residential, 548 commercial, and 97 agricultural (irrigation only)(7). The Fair Oaks Water District serves approximately 38,000 people. Since 1956, the Fair Oaks Water District's primary water supply source has been from Folsom Lake via the San Juan Suburban Water District's surface water treatment plant. In addition, Fair Oaks has eight groundwater wells (Fair Oaks Wells 1-9, there is no #2) located on the bluff north of the American River (Figure 2)(7). These wells are used to augment the surface water supply from the San Juan Suburban Water District supply during high demand or for fire protection. All of these wells were in service in the summer of 1997 (8). Over the course of the year, the wells contribute approximately 5% of the water used by the Fair Oaks Water District (8).

DISCUSSION

In February 1997, Aerojet, as a part of their ongoing monitoring of certain off-site public drinking water wells, detected perchlorate in five off-site public drinking water wells west of Aerojet and north of Mather Field (none of these are Fair Oaks wells)(9). To analyze these water samples, Aerojet used a refined or improved analytical method such that instead of the previous reporting level of 400ppb, they were able to obtain a detection limit of 35ppb. The five drinking water wells showed detectable levels of perchlorate ranging from 92 to 280 parts per billion (ppb) with a detection limit of 35 ppb. Subsequent re-testing of the wells showed comparable levels. These detectable levels of perchlorate exceeded the concentration (4 to 18ppb) suggested by the USEPA provisional reference dose (1 to 5E-4 mg/kg/day) based on a 70 kg individual consuming 2 liters of water a day (10).

In March 1997, the Sacramento District field staff of the CDHS Division of Drinking Water (DDW) sampled 41 public water supply wells in the area of the known perchlorate contaminated wells, including Fair Oaks well #8 (11). The well samples were processed by the CDHS's Radiation and Sanitation Laboratory with a detection limit of 4ppb. No detectable level of perchlorate was found in Fair Oaks well #8.

The DDW field staff continued to monitor for perchlorate in drinking water sources, focusing on wells located to the west of Aerojet General property. In June, DDW staff sampled 47 locations, including three Fair Oaks Water District wells, #1, 4, and 8 (11). No detectable levels of perchlorate were detected in these Fair Oaks wells.

A trichloroethylene (TCE) plume that originated from Aerojet has crossed the American River and is approaching but has not reached Fair Oaks wells #1, 4, and 8 (Figure 3). There is concern that perchlorate which has been detected in monitoring wells on the northern edge of the Aerojet site boundary may be moving toward the Fair Oaks wells. Two of five Cordova System wells located between the Aerojet northern site boundary and the American River have had detectable but not quantifiable (<4ppb) perchlorate measured in the well water.

Community Concerns

Fair Oaks Water District reports that they have not had any concerns about perchlorate exposure come from their customers (8). This may be due to Fair Oaks Water District communicating early in 1997 with their customers to information about the nearby perchlorate contamination problem in their quarterly fact sheet (Attachment A).

Exposure Pathway Analysis

The sampling of Fair Oaks wells has shown no quantifiable levels of perchlorate. However, the Fair Oaks System typically uses surface water for its water supply.

For a target population to be exposed to environmental contamination, there must be a mechanism by which that contamination comes into direct contact with the target population (12). An exposure pathway is the description of this mechanism. A completed exposure pathway consists of five parts: a source of contamination, an environmental medium and transport mechanism, a point of exposure, a route of exposure, and a receptor population. For a population to be exposed to an environmental contamination, a completed exposure pathway (all five elements) must be present. If any one of these is missing, then there is no exposure, though the presence of contamination may still be significant and require remediation. This is especially true if there is a possibility of an in complete exposure pathway becoming complete in the future.

Exposure pathways are classified as completed, potential, or eliminated. A complete exposure pathway is one in which all five elements of the pathway are present, or will be present in the future. It may also be described as a potential pathway if information on one of the elements of the pathway is missing. An eliminated pathway is one in which one or more of the elements is missing and will never be complete in the future.

CDHS considers that no past or current exposure pathway exists with the Fair Oaks Water District because no perchlorate is being delivered to the user. CDHS estimates there may be a potential future exposure pathway from perchlorate-contaminated water, if the perchlorate groundwater plume moves north of the American River and the groundwater wells are used as a domestic water source for the Fair Oaks Water District.

CONCLUSIONS

Based upon the information reviewed, no customers of the Fair Oaks Water District have received water contaminated with perchlorate. In the future, if perchlorate does reach these wells, exposure could occur.

PUBLIC HEALTH RECOMMENDATIONS AND ACTIONS

The Public Health Recommendations and Actions Plan (PHRAP) for this site contains a description of actions take, to be taken, or under consideration by ATSDR and CDHS at and near the site. The purpose of the PHRAP is to ensure that this health consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The CDHS and ATSDR will follow-up on this plan to ensure that actions are carried out.

Recommendations for Further Action:

1. Continue monitoring Fair Oaks Water District wells and be prepared to address the possible contamination of these wells.

REFERENCES

1. U.S. Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation. Preliminary Health Assessment of the Aerojet-General Corporation, Rancho Cordova, CA. December 5, 1988.

2. Environmental Health Investigations Branch California Department of Health Services. Site Review and Update of the Aerojet-General Corporation, Rancho Cordova, CA. Prepared for U.S. Agency for Toxic Substances and Disease Registry. March 19, 1993.

3. Environmental Health Investigations Branch California Department of Health Services. Health Consultation- Trichloroethylene Levels in Private Wells near the Aerojet-General Corporation, Rancho Cordova, CA. Prepared for U.S. Agency for Toxic Substances and Disease Registry. July 1996.

4. Environmental Health Investigations Branch California Department of Health Services. Health Consultation- Hazel Avenue Ponds near the Aerojet-General Corporation, Rancho Cordova, CA. Prepared for U.S. Agency for Toxic Substances and Disease Registry. November 18, 1996.

5. Environmental Health Investigations Branch California Department of Health Services. Health Consultation- Review of Methods of Analysis for the Perchlorate Anion, Aerojet-General Corporation, Rancho Cordova, CA. Prepared for U.S. Agency for Toxic Substances and Disease Registry. March 18, 1997.

6. Environmental Health Investigations Branch California Department of Health Services. Health Consultation- American River Study Area of the Aerojet-General Corporation,

Ranch Cordova, CA. Prepared for U.S. Agency for Toxic Substances and Disease Registry. February 21, 1996.

7. California Department of Health Services, Drinking Water Field Operations Branch in Sacramento. Annual Inspection Report of the Fair Oaks Water District. May 16, 1997.

8. Fair Oaks Water District, Operations Manager. Telephone conversation, concerning Fair Oaks Water District and Perchlorate Concerns. September 3, 1997.

9. California Regional Water Quality Control Board, Central Valley Region, Senior Water Resource Control Engineer. Memorandum to Aerojet file, concerning Meeting on Perchlorate Sampling on 2-11-97. February 11, 1997.

10. National Center for Environmental Assessment, U.S. Environmental Protection Agency, Associate Director. Letter with attached report written to the Chairman of the Perchlorate Study Group, concerning Review of Proposed RfD for Perchlorate. October 23, 1995.

11. California Department of Health Services, Drinking Water Field Operations Branch, Sacramento. Perchlorate Monitoring Data: 3/11/97 through 6/23/97. July 25, 1997.

12. U.S. Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual. Lewis: Boca Raton, 1993.

PREPARERS OF REPORT

ENVIRONMENTAL AND HEALTH EFFECTS ASSESSORS:

Marilyn C. Underwood, Ph.D.
Staff Toxicologist
Environmental Health Investigation Branch
California Department of Health Services

COMMUNITY RELATIONS COORDINATOR:

Jane Riggan, M.S.W.
Public Health Social Work Consultant II
Environmental Health Investigations Branch
California Department of Health Services

ATSDR REGIONAL REPRESENTATIVES

William Nelson
Gwendolyn Eng
William Deviny
Dan Strausbaugh
Agency for Toxic Substances and Disease Registry Region IX

ATSDR TECHNICAL PROJECT OFFICER:

William Greim
Environmental Health Scientist
Division of Health Assessment and Consultation
Superfund Site Assessment Branch, State Programs Section

CERTIFICATION

This Perchlorate Contamination in the Fair Oaks District, Aerojet-General Corporation Health Consultation was prepared by the California Department of Health Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Technical Project Officer, SPS, SSAB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.

Chief, SPS, SSAB, DHAC, ATSDR

APPENDIX A. RESPONSE TO COMMENTS FROM SITE TEAM REVIEW

In 1995, EHIB formed a site team to assist us in identifying public health concerns and to oversee what we do during the health assessment process for the Aerojet General site. The site team is composed of community residents, environmental and health agency staff, Aerojet staff, as well as EHIB staff. Health consultations that are produced as apart of the health assessment process are released for comment to site team prior to them becoming final. We received comments on this health consultation from the Drinking Water Branch of CDHS, DTSC, Aerojet, and RWQCB. In this appendix, we will respond to the submitted comments.

COMMENTS RECEIVED FROM THE DRINKING WATER BRANCH OF CDHS

The Drinking Water Branch of CDHS regulates water purveyors in the state, and their comments were minor technical corrections to the numbers we cited in the text. These corrections were made to the original document.

COMMENTS RECEIVED FROM THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Below are DTSC's comments which may be considered as the documents are finalized.

DTSC comment: In the third paragraph of the consultations, it is stated that the Regional Water Quality Control Board is the lead regulatory agency. While this is correct for some aspects of the project, the lead regulatory agency controlling water district activities is the Department of Health Services, Office of Drinking Water. For matters concerning the Aerojet Superfund Site, the United States Environmental Protection Agency is the lead federal regulatory agency. A co-lead situation exists for certain matters covered under the Aerojet Superfund Site Partial consent Decree (United States District Court, Eastern District of California, Civil Action Nos. CIVS-86-0063-EJG and CIVS-86-0064-EJG).

CDHS response: Being a part of the complex government oversight at this site, we appreciate the clarification to the agency responsibilities. We have tried to rectify this in the text.

COMMENTS RECEIVED FROM AEROJET GENERAL CORPORATION:

Aerojet's comment about the attribution of source of the perchlorate in public water supply wells: Each draft Health Consultation assumes that perchlorate being found in public water supply wells came from the Aerojet Operating Plant, specifically from the reinjection wells associated with the GET facilities. There are numerous locations where such references appear:

We are aware of no detailed evaluation of sources, groundwater conditions and groundwater and contaminant movement undertaken by DHS or any other agency that would support statements in

the DHS Consultations that attempt to link perchlorate in a well to an upgradient source, and it does not appear necessary for DHS to ascribe a source to reach its conclusions. The Health Consultations should identify that potential sources of perchlorate include the Aerojet Operating Plant, Purity Oil site, and the McDonnell Douglas (MDC) Site. DHS should not assert that the only source of the perchlorate is the GET facility recharge wells on the Aerojet Operating Plant. Neither should the period of operation of the GET wells form the basis for assumptions of exposure of potential receptors. As the Health Consultations discuss potential sources, it should discuss the various uses of perchlorate, other than in rocket motor manufacturing, such as the use of perchlorate in pyrotechnics (fireworks), explosives and other industrial activities. It should also note that perchloric acid, which is used in various industrial activities, including metal-plating, in laboratories, and in other operations, when released can result in the formation of perchlorate and its movement into soils and groundwater.

Aerojet believes that there have been no health impacts associated with any exposure to perchlorate in the water supply. If the Health Consultations seek to discuss long term impact by assuming exposure for some period (e.g., 10 years), they can do so without assigning a source, but simply by positing the potential for such exposure (without reference to a source) and developing an exposure assessment.

CDHS response: These health consultations are written as a part of CDHS's public health review of the impact of the Aerojet General site. Thus, the documents are written in respect to Aerojet General and not to other sites or facilities. We do recognize that perchlorate may have also gotten into the groundwater from sources other than Aerojet and that is why in last sentence of the third paragraph on page 1, we refer to the RWQCB's investigation of "other sources of the perchlorate such as the McDonnell Douglas (now Boeing) and Purity Oil Sales sites."

Aerojet's comment about the water system operations: The draft Health Consultations, especially in the background sections, contain statements of fact as to the manner of well and system operation of each water entity over time, including detail on well construction and operation in tables. Aerojet has not had an opportunity to complete an evaluation of the accuracy of such statements. We further note that the factual statements generally do not seem to impact the exposure assessment, as the exposure assessment is based upon an assumed concentration that is not generally associated with the specifics of well interties or well operation. We would recommend the Health Consultations state that the water system information is based on current understanding unless DHS has had the opportunity to perform a detailed evaluation of the information.

CDHS response: In each health consultation we cite the CDHS reports or other reports from which we gained this information. We refer Aerojet to those documents if Aerojet would like to evaluate the accuracy of such statements. We do think it is important to describe for the reader the basic structure of a particular water system; on the other hand we don't want to add more information then is necessary. We hope that the amount of information we have provided will

allow a Fair Oaks System customer to more easily understand that none of the water wells in the system have been contaminated with perchlorate.

With these general comments identified, we now progress to the specifics. We use the Arden Cordova Health Consultation as the template for our comments, and emphasize that typically the same issue exists in the other draft Health Consultations.

Aerojet's comment: Page 1, Paragraph 2 and Throughout: The term "perchlorate contamination" is subject to misinterpretation and references should be to "water containing perchlorate" or like phrase.

CDHS's response: In Webster's New Collegiate Dictionary, it says "contaminate" means "to make impure or unclean". Perchlorate is not typically found in groundwater, as would be the case with certain chemicals like arsenic or sulfates which are naturally occurring in groundwater. Thus it does seem appropriate to describe the "contamination" of groundwater by a chemical such as perchlorate. Likewise, it may be appropriate to describe "water containing arsenic" if you are describing water which contains unusually high levels of arsenic due to natural reasons and arsenic-contaminated water if higher levels than normal may be due to non-natural reasons.

Aerojet's comment: Page 1, Paragraph 3: The description of Aerojet operations and Cordova operations has been taken from earlier documents. Aerojet has historically pointed out the inaccuracies in the statements and rather than do so again we recommend, at a minimum, elimination of a reference to Cordova Chemical Company, because we do not believe it used perchlorate. We also recommend an elimination of the reference to the deep injection wells, because they are not relevant to the issue and can result in confusion when there is later discussion about recharge or reinjection wells associated with the GET facilities, which are different wells.

CDHS response: In the background paragraph, we are describing the lay of the land regarding the general site issues and thus we did not directly suggest that Cordova Chemical did use perchlorate, but rather this company was a part of the history of the site. Since perchlorate is reinjected at the site boundary as a part of the GET operations, we do not agree that reference to these should be eliminated.

Aerojet's comment: Page 1, Paragraph 3: Delete "property" after "Aerojet's."

CDHS response: This incorrect grammar has been corrected in the text.

Aerojet's comment: Page 1, Paragraph 3: Aerojet is not reinjecting treated water at the site's northern boundary.

CDHS response: This has been changed in the text.

Aerojet's comment: Page 1, Paragraph 3: The Regional Water Quality Control Board (RB) is not the lead Agency; DTSC, USEPA and RB together provide oversight pursuant to the Partial Consent Decree.

CDHS response: The description of the lead agency/agencies was changed in the text.

Aerojet comment: Page 3, Paragraph 1: The discussion as to detection of perchlorate ought to be rewritten. Prior to the summer of 1996, Aerojet's laboratory used an ion specific electrode method. In 1997 Aerojet's laboratory did not use a different analytical method for perchlorate analysis to obtain the detection limit of 35 ppb but rather refined or improved the sensitivity of the existing ion chromatography method. In addition, it is accurate to say the "method" detection limit.

CDHS response: Based on this comment and a similar comment by other reviewers, the description of the analytical method was revised in the text.

COMMENTS FROM THE CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

Regional Board staffs comments on the documents are supplied below.

RWQCB General Comment: We recommend that the use of the term "contaminated" be selectively used. Contaminated should be used when the water represents a hazard to the public health. In the case of perchlorate, "contaminated" should not be used when discussing concentrations less than 18 ppb. It is even unclear whether the term should be applied to those concentrations that are currently found in some of the groundwater supply wells (up to 300 ppb). Instead of saying "perchlorate-contaminated water", we would recommend saying "water containing perchlorate"

CDHS response: As was stated under a similar comment raised by Aerojet, in Webster's New Collegiate Dictionary, it says "contaminate" means "to make impure or unclean". Perchlorate is not typically found in groundwater, as would be the case with certain chemicals like arsenic or sulfates which are naturally occurring in groundwater. Thus it does seem appropriate to describe the "contamination" of groundwater by a chemical such as perchlorate. Likewise, it may be appropriate to describe "water containing arsenic" if you are describing water which contains unusually high levels of arsenic due to natural reasons and arsenic-contaminated water if higher levels than normal may be due to non-natural reasons.

RWQCB General Comment: There is a paragraph in each of the health consultations which discusses the "reporting level to the RWQCB" of 400 ppb and a change in method which allowed

for a detection level of 35 ppb. In the early 1990's, up until around 1995/96, Aerojet was using a ionspecific electrode to measure perchlorate concentrations in water with a detection level of 400-500 ppb. Aerojet then developed an alternate method using a GC which provided a detection level of 35 ppb and a reporting level of 400 ppb. This method was then used by Aerojet in all work required under the Partial-Consent Decree. In early 1996 RWQCB staff requested Aerojet to report all concentrations between the detection level (35 ppb) and reporting level (400 ppb) as trace. Aerojet was then able to lower their PQL to 100 ppb, while maintaining their detection level at 35 ppb. No method changes were made to get to the lower reporting level. It was in February 1996 that the concentrations in the off-site water supply wells were first reported.

CDHS response: Based on this comment and comments by others, the text was revised.

Figure 1
Perchlorate Groundwater Plume in Relation to Aerojet and the Fair Oaks Water District

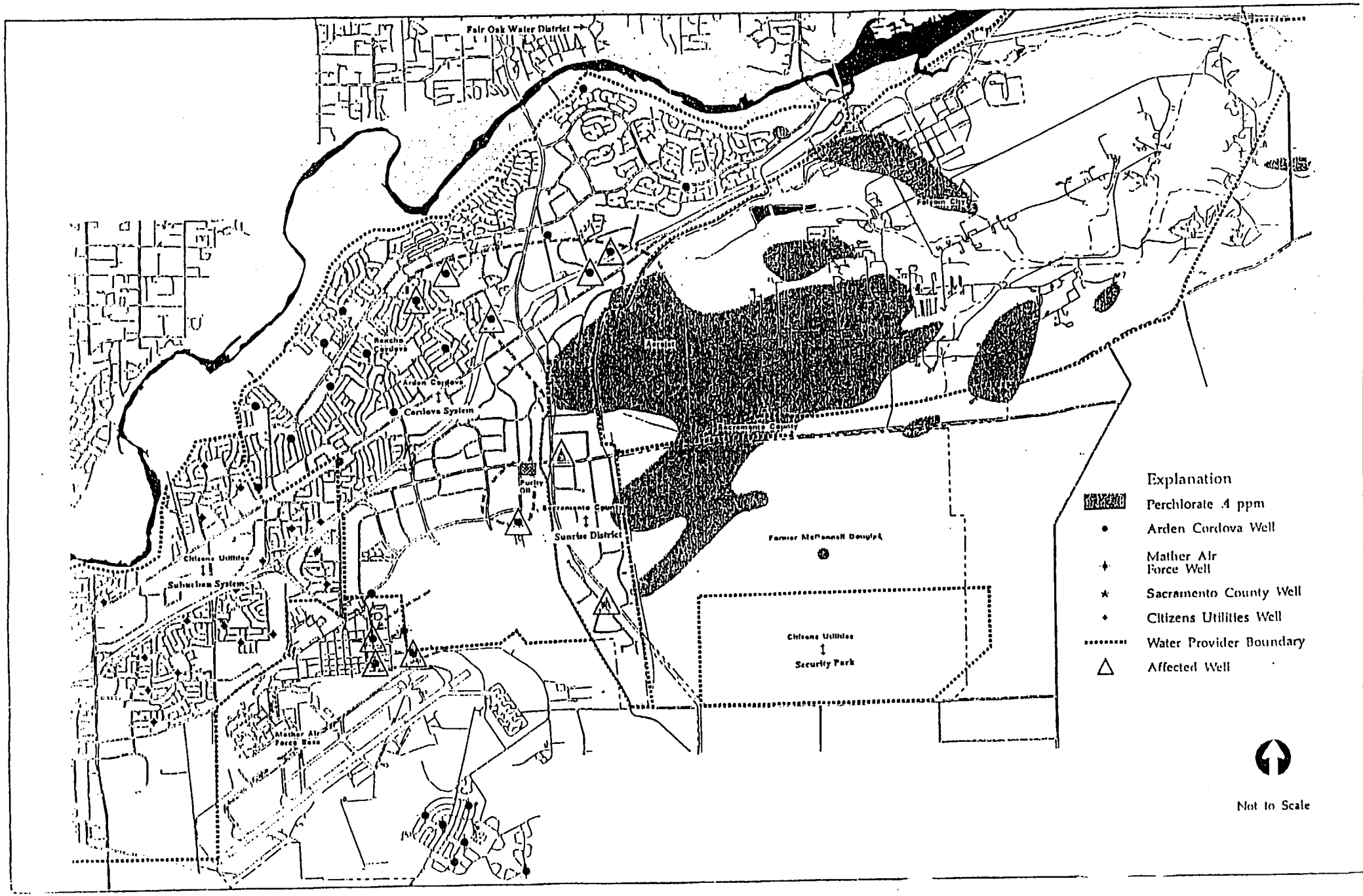


Figure 2
Fair Oaks Water District and Groundwater Well Locations

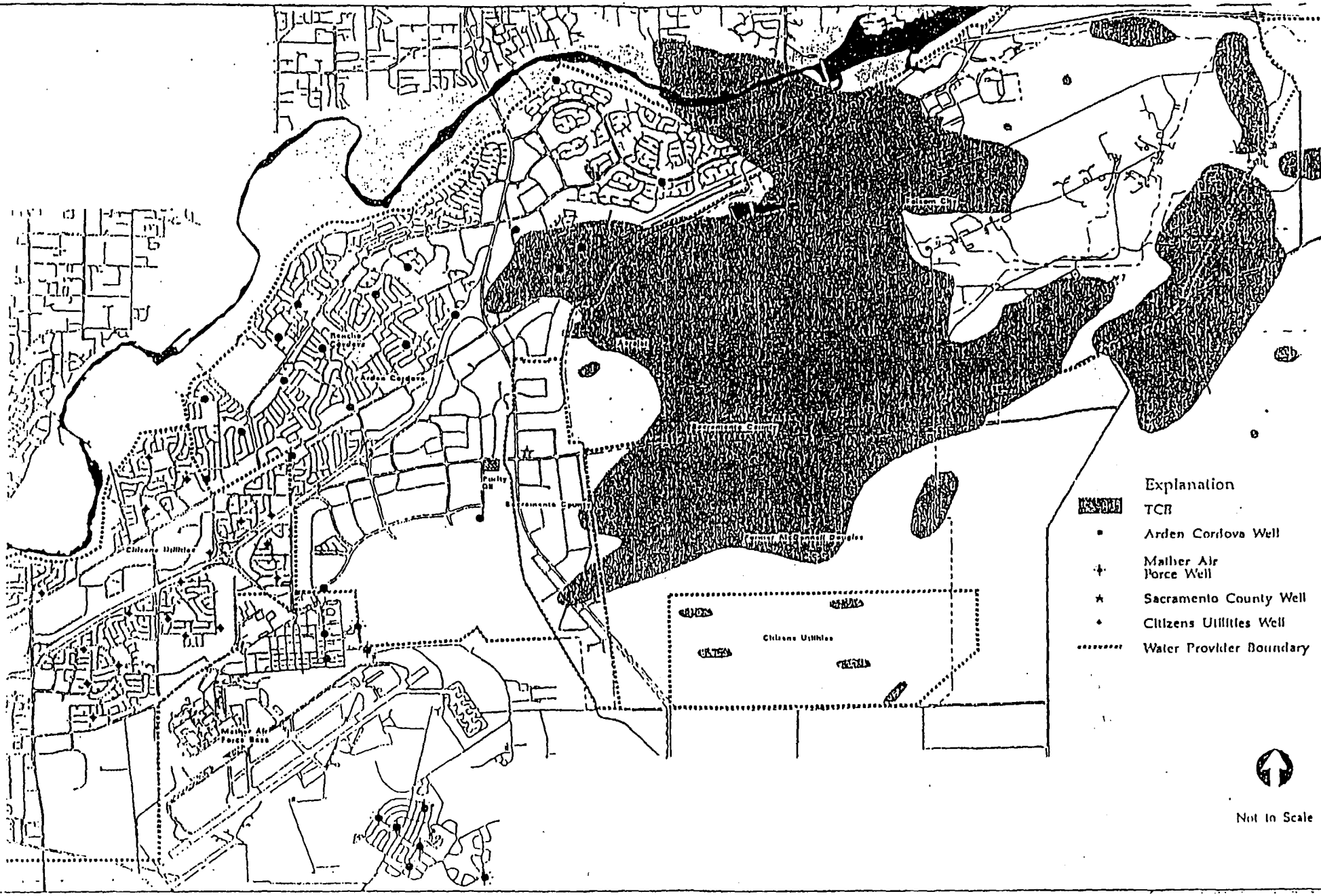
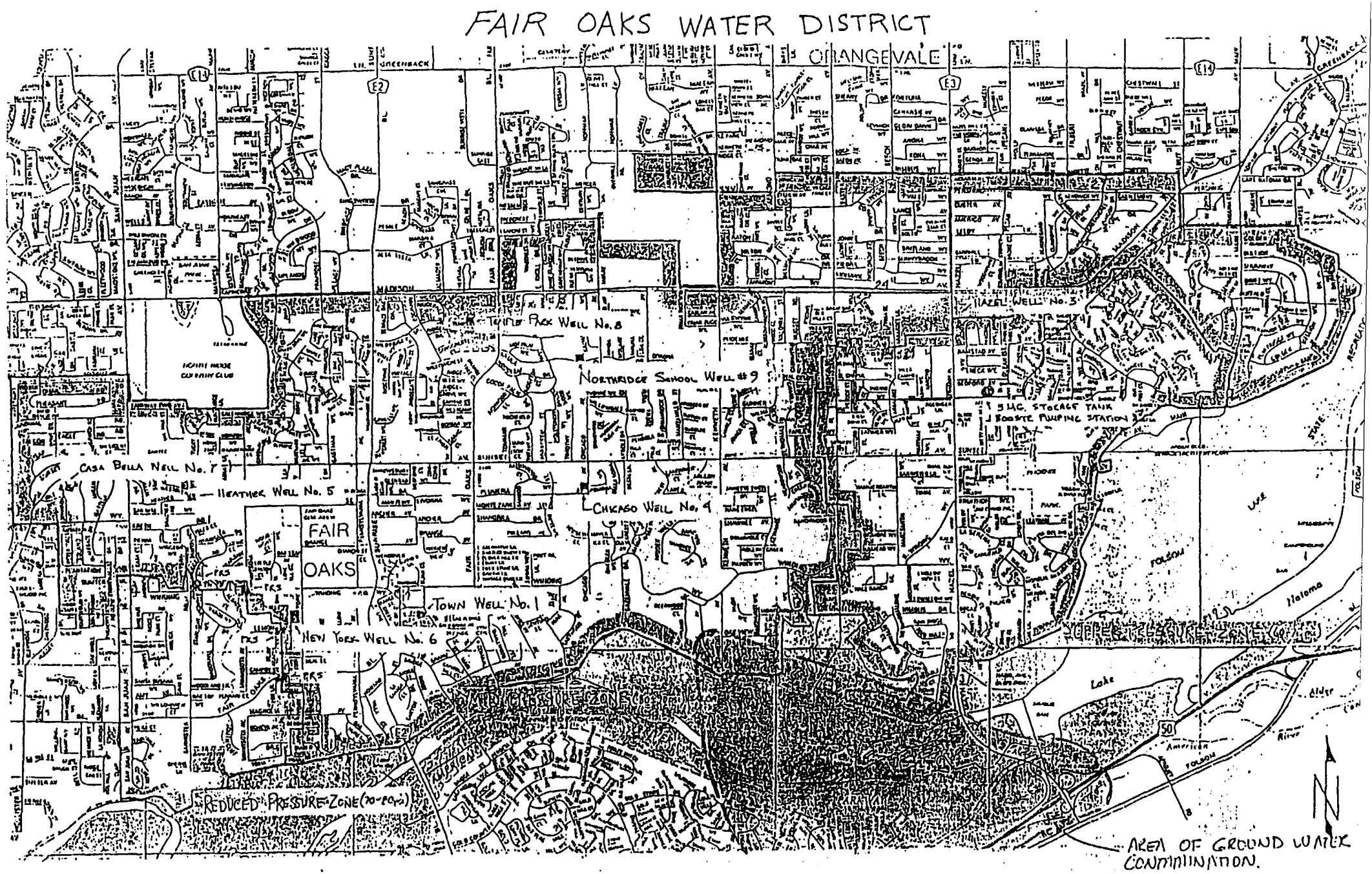


Figure 3
Trichloroethylene Groundwater Plume in Relation to
Aerojet and the Fair Oaks Water District



Attachment A

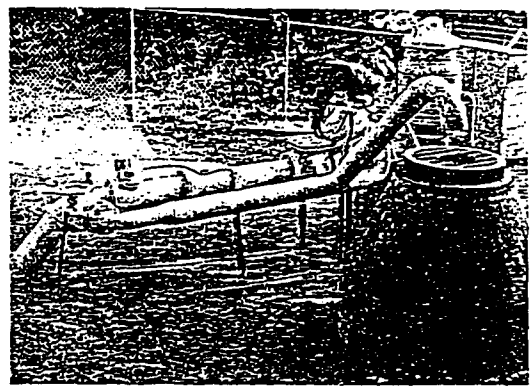
Water Currents

FAIR OAKS WATER DISTRICT

Volume. 7
Number 1
Spring, 1997

Water Quality Is Our Business

You have a right to know what is in your water. Should a potential threat to the water supply loom, it is our business to keep you informed. Maintaining high quality water and communicating with customers are high priorities at Fair Oaks Water. A few timely issues are worthy of your attention.



As a precautionary move, FOWD's Chicago Well has been temporarily removed from service.

Perchlorate Provokes Regional Concern

In the last *Water Currents*, we talked about the trichloroethylene (TCE) plume from Aerojet. A new threat has emerged to groundwater around Aerojet from another chemical. The latest concern centers on an oxidizer called perchlorate, which is used by the aerospace industry in some solid fuel rockets. Methods effective in removing TCE from drinking water are not effective in removing perchlorate. Tests taken at monitoring wells show perchlorate in groundwater has migrated westward from Aerojet to wells within Rancho Cordova. As of this writing, seven public water supply wells south of the American River have been shut down.

Health officials who have charted perchlorate's advance say that Fair Oaks groundwater is not in the plume's path.

State health officials are seeking a way to eliminate perchlorate from groundwater. As yet, no proven means of removal is available.

Health concerns from perchlorate relate to its reaction with iodine inside the body. The chemical, in higher concentrations can metabolize enough iodine in humans to cause harm. Health officials who have charted the movement of groundwater say that Fair Oaks groundwater is not in the path of the plume.

Perchlorate at Aerojet was disposed of in a different site than TCE. Hence, perchlorate contamination is following a more southerly and westerly path.

Studies are underway by officials on the best means of replacing the water supply lost to perchlorate contamination. Once studies are complete, we, at Fair Oaks might be asked to convey water through our distribution system to portions of Rancho Cordova. Any associated costs would be borne by others, not Fair Oaks rate payers, but as a good neighbor, Fair Oaks Water District will continue to help when needed.